

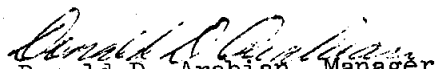
APOLLO 11

PROBLEM AND DISCREPANCY LIST

November 5, 1969

Note: Discussion of closed problems will be
deleted from subsequent updates.

Italics indicate change from previous issue.


Donald D. Arabian, Manager
Mission Evaluation Team

NOV 7

1969

INDEXING DATA

DATE
11-05-69

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PGM
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SUBJECT
(Title)

SIGNATOR
ARABIAN

LOC
078-63

SUMMARY LIST

COMMAND AND SERVICE MODULES

<u>No.</u>	<u>Title</u>	<u>Status</u>
1	Service module propellant isolation valve closure	Closed
2	Condenser exit temperature drop	Closed
3	Low oxygen flow rate	Closed
4	High oxygen flow master alarm while oxygen flow decreasing	Closed
5	Service propulsion system B nitrogen leak	Closed
6	Improper operation of glycol mixing valve	Open
7	Cryogenic oxygen tank 2 heater failure	Closed
8	Data storage equipment inoperative during entry	Closed
9	VHF ranging unable to maintain lock during rendezvous	Closed
10	After separation, system 1 negative yaw engine did not respond to automatic commands	Open
11	High gain antenna oscillations during docking	Closed
11	Tunnel odor	Closed
11	Entry monitor system residuals after service propulsion maneuvers	Closed
14	Entry monitor system electroluminescent segment failure	Closed
15	Digital autopilot stoppage of turnaround maneuver after command and service module separation from S-IVB	Closed
16	Entry monitor system velocity change during S-IVB separation and turnaround maneuver	Closed
17	Lower equipment bay mission clock slow operation and cracked glass	Closed
18	All tie wraps but one were found untied during postflight testing	Closed
19	Flight director attitude indicator differed from predicted by 1.5 degrees during translunar injection firing	Closed
20	Crew reported seeing flashes of light in the command module during transearth coast	Closed
21	<i>Improper service module entry</i>	<i>Closed</i>

COMMAND AND SERVICE MODULE PROBLEM LIST

TIME: CSM/S-IVB separation

CSM-1

DESCRIPTION: Primary and secondary propellant isolation valves on service module reaction control quad B showed "barberpole" indication at pyrotechnic firing for separation. The same condition occurred on Apollo 9.

DISCUSSION: After the Apollo 9 problem tests were conducted to resolve the problem. The results were somewhat inconclusive as to the exact cause of the closure, but it was believed that if the valves did close at adapter separation during subsequent missions, the valves could be reopened and no further problems would arise. Consequently, checklist procedures were so written.

The checklists for Apollo 12 and subsequent have been changed to include verifying the position of additional valves.

TIME: Throughout flight

CSM-2

DESCRIPTION: Condenser exit temperature on fuel cell 2 suddenly drops about 1° to 2° F every 5 minutes and recovers.

DISCUSSION: Indications are that the peculiarity which causes the disturbances is directly associated with the cooling fluid stream. A further review of data from all previous missions indicates that similar behavior has been exhibited by either fuel cell 2 or fuel cell 3 on every mission, starting with Apollo 7.

A meeting was held at MSC on September 11 and 12, with NR and P&W to discuss the results of their independent investigations of the cause of the temperature disturbance. The cause has been narrowed to two possibilities: (1) water buildup and subsequent "slugging" out of the condenser or the plumbing immediately downstream of the condenser, and (2) gelatinous contamination periodically plugging the secondary bypass valve flow areas. In-depth examination of these two possibilities has shown no implications of fuel cell malfunctions on future flights any more serious than experienced previously. No further investigation is planned, as all possible causes have been explored as far as practical.

A report has been submitted, and the results will be made available in a separate anomaly report.

TIME: 2 Hours

DESCRIPTION: Indicated oxygen flow rate was 0.2 to 0.3 lb/hr during cabin oxygen enrichment purge; should have been 0.98 lb/hr.

DISCUSSION: *The following discussion was lifted from the 30-day report. Therefore, the reference to figures is not pertinent, although the figures may be viewed in that report, if published.*

Analysis of associated data indicated that the oxygen flow was normal, but the indicated flow rate was negatively biased by 1.5 lb/hr. Postflight tests of the transducer confirmed this bias, and the cause was associated with a change in the heater winding resistance within the flow sensor bridge (fig. 4). The resistance of the heater had increased from 1000 to 1600 ohms, changing the temperature of the hot wire element which supplies the reference voltage for the balance of the bridge. Further testing to determine the cause of the resistance change is not practical because of the minute size of the resistive element and de-potting would be required. Normally, the heater resistance changes have occurred early in the 100-hour burn-in period, and heater stability is achieved.

A generic problem is not indicated; therefore, no action will be taken.

ASSIGNED TO: Hurt, NR

ASHUR NO: 107001

Anomaly Report

TIME: 55 Hours

DESCRIPTION: Two improper master alarms were noted during lunar module pressurization (54:56:09 and 55:01:45).

DISCUSSION: *This discussion too!*

These alarms were activated when the oxygen flow rate was decreasing from full-scale. The same condition had been observed several times during altitude-chamber tests and during subsequent troubleshooting. The cause of the problem could not be identified before launch, but the only consequence of the alarms was the nuisance factor. Figure 3 shows the basic elements of the oxygen flow sensing circuit.

Note in figure 3 that in order for a master alarm to occur, relay K1 must hold in for 16 seconds, after which time relays K2 and K3 will close, activating a master alarm.

The capacitor shown is actually a part of an electromagnetic interference filter and is required to prevent fluctuation of the amplifier output to the voltage detector. Without the capacitor for a slow change in flow rate in the vicinity of the threshold voltage of K1, relay K1 will continuously open and close (chatter).

Relay K2 has a slower dropout time than K1; therefore, if relay K1 is chattering, relay K2 may not be affected, so that the 16-second time delay continues to time out. Consequently, master alarms can be initiated without resetting the 16-second timer.

The filter capacitor was open during postflight tests, and the master alarms were duplicated with slow, decreasing flow rates.

There has been no previous failure history of these metalized Mylar capacitors associated with the flow sensors. No corrective action is required.

ASSIGNED TO: Hurt, NR

ASHUR NO: 107001

Anomaly Report

TIME: Lunar orbit insertion

CSM-5

DESCRIPTION: Service propulsion gaseous nitrogen pressure in bank B decayed from 2250 to 1950 psia during lunar orbit insertion firing; pressure remained constant after cutoff, indicating leak downstream of regulator.

DISCUSSION: Only one side of the redundant system was affected, and the pressure drop was not detrimental to service propulsion system performance.

Both banks were used for the transearth injection maneuver, with no indication of a leak.

Data review has been completed and no testing is required. The observed condition was leakage past the vent port of a 3-way valve. The leakage resulted from contamination.

Anomaly Report

COMMAND AND SERVICE MODULE PROBLEM LIST

TIME: 105 hours

DESCRIPTION: The primary water/glycol evaporator outlet temperature decreased to 31° F.

DISCUSSION: *The 2.42 valve was disassembled and a bearing was found to be failed. The ball bearing spacer/retainer was found out of place and interfering with the valve drive mechanism. The opinion of independent bearing analysts is that the bearing lubrication film on each ball was "squeezed" off the surface resulting in bearing wear. The analysts opinion was that the lubricant was improper for the application.*

IN PROGRESS: *Bearings to be run without lubrication at the vendor.*

COMPLETION: 8 December 1969

ASSIGNED TO: Hurt, NR

TIME: 160 Hours

DESCRIPTION: The automatic heater pressurization cycles for oxygen tank 2 required more time than expected to return tank pressures to desired limits. This condition, although not realized, did exist prior to lift-off, as shown by prelaunch current measurements, which indicate that one heater element in cryogenic oxygen tank 2 was failed open.

DISCUSSION: Data showing heater currents for prelaunch checkout verified that both heater elements were operational through the countdown demonstration test. However, the current readings recorded during the tank pressurization in the launch countdown showed that one heater in oxygen tank 2 had failed. This information was not made known to proper channels for disposition prior to the flight, since no specification limits were called out in the test procedure.

Manufacturing records for all block II oxygen tanks showed that there have been no thermal-shock nor electrical-continuity failures in the program; two failures occurred during the insulation resistance tests. One failure was attributed to moisture in the connector. This unit was dried and then passed all acceptance tests. The other failure was identified in the heater assembly prior to installation in a tank. This was also an insulation problem and would not have prevented the heater from functioning normally.

The cause of the flight failure was probably a Deutsch terminal board in the heater circuit. Wiring at the board is 16-gage, which has resulted in intermittent functions several times in the past. This is the same type terminal board that was found to be the cause of the thruster problem in this flight (see CSM-10).

Since the oxygen tank heaters are redundant, no constraints to the mission were created, other than a requirement for more frequent quantity balancing.

The launch-site test requirements have been changed to specify the amperage level to verify that both tank heaters are operational. Additionally, all launch-site procedures are being reviewed to determine whether specification limits are required in other areas.

ASSIGNED TO: Ferguson

Anomaly Report

TIME Entry

CSM-8

DESCRIPTION: The data storage equipment (tape recorder) did not turn on for entry.

DISCUSSION: The crew technical debriefing indicates that the circuit breaker which provides ac power to the recorder and the FM transmitter was left open after the last television transmission. The crew procedure was to pull the breaker when it was desired to have power on the television camera and monitor but not transmit the video. The checklist was correct but was not followed.

Aug 14/1969

Anomaly Report

TIME: Rendezvous

DESCRIPTION: The VHF ranging was reported to have broken lock a number of times during the period from ascent through rendezvous. The Command Module Pilot, in the Technical Debriefing, stated, "After CDH, I was able to get VHF marks only for a little while."

DISCUSSION: The VHF ranging problem appears to have resulted from poor VHF link circuit margins. Based on crew comments, the lunar module VHF antenna switching was per the crew checklist.

VHF circuit margins were computed from the dropout times logged by the Command Module Pilot. *Results indicate that the VHF ranging dropouts were caused by insufficient VHF circuit margins resulting primarily from normal attitude excursions at the specific dropout range.*

Crew Briefing

TIME: Entry

DESCRIPTION: The crew reported that the system 1 negative yaw command module reaction control system engine did not perform normally during the entry phase using the automatic coils. However, the engine did perform normally when the direct coils were energized.

DISCUSSION: Electrical continuity through at least one of the parallel automatic coils in the engine was evidenced by the fact that the stabilization and control system driver signals were normal. This, along with the fact that at least some thrust was produced, indicates that one of the two valves was working normally.

During checkout at the launch site, another engine had failed to respond to commands during the valve signature tests. The problem was isolated to a faulty terminal board connector. This terminal board was replaced and the systems were retested satisfactorily. Because of this incident and because of the previous history of problems with the terminal boards, these connectors were a prime suspect.

Postflight tests showed that two pins in the terminal board were loose and caused intermittent continuity to the automatic coils of the engine valve. This type failure has been noted previously on terminal boards manufactured prior to November 1967. This board was manufactured in 1966.

The intermittent contact was caused by improper clip position relative to the bus bar counterbore. This results in loss of some side force, which precludes proper contact pressure against the bus bar. A design change to the base gasket was made to positively insure that the bus bar is correctly positioned.

IN PROGRESS: A search of installation records is in progress to determine the location of any Criticality II pre-November 1967 terminal boards in Spacecraft 108 and subsequent to assess what problems could arise during the mission, and if corrective action is required for the particular applications.

ASSIGNED TO: NR, Kingsley

COMPLETION: 16-gage terminal board matrix, Spacecraft 108 thru 113 - complete.
NR recommendation for Spacecraft 108 - September 23.
20-gage - October 3.
Complete matrix - November 17

ASHUR: 107014

TIME: Docking

DESCRIPTION: The Commander, in the lunar module, noted that the command service module high gain antenna was oscillating 15 to 20 degrees in both pitch and yaw.

DISCUSSION: Acquisition of signal with the ground station was made on an omni antenna, as planned. In this configuration, if power is on the high gain antenna, the antenna will "hunt" or oscillate because of transients on the track error line. The antenna operated without problems when it was selected.

The antenna motion did not cause any difficulty.

Aug 14, 1969

TIME: Translunar

CSM-12

DESCRIPTION: A peculiar odor was detected in the tunnel upon opening the hatch after transposition and docking. The odor was particularly strong upon first opening the hatch; however, the odor did persist throughout the flight. The crew characterized the odor as being that of burned or charred wire insulation.

DISCUSSION: *The Commander and the Command Module Pilot identified the forward hatch ablator material as the source of the odor during a special test on September 23. This odor can be expected during future flights.*

Anomaly Report

TIME: Each service propulsion maneuver

CSM-13

DESCRIPTION: The crew reported concern over the residuals observed in the entry monitor system following each service propulsion maneuver.

DISCUSSION: Comparison of the residuals with guidance and navigation measured velocities indicates excellent correlation and normal operation. The velocity set into the counter is less than the desired velocity by the anticipated tailoff velocity. Therefore, the counter, which would issue an engine-off command when the reading passes through zero if prime for the maneuver, indicates an overburn by an amount equal to tailoff.

Aug 14, 1969

Crew Briefing

TIME:

Unknown

CSM-14

DESCRIPTION: The lower horizontal electroluminescent segment on one of the entry monitor system velocity counter digits was reported out.

DISCUSSION: The electroluminescent segment is independently through a logic network which activates a silicon-controlled rectifier to bypass the light when not illuminated. The power source is 115 volts, 400 hertz.

Four cases of similar malfunctions have been recorded. One involved a segment which would not light; three involved segments which would not turn off. In each case, the cause was identified as misrouting of logic wires in the circuit controlling the rectifiers. The misrouting bent the wires across terminal strips containing sharp wire ends. These sharp ends punctured the insulation and caused shorts to ground or to plus 4 volts, turning the segment off or on, respectively.

A rework of the affected circuits took place in the process of soldering crimp joints involves an Apollo 7 anomaly. An inspection to detect misrouting was conducted at this time; however, because of potting restrictions, the inspection was limited. A number of other failure mechanisms exist in circuit elements and leads; however, there is no associated failure history. A generic or design problem is considered unlikely because of the number of satisfactory activations sustained to date.

The integrated test for spacecraft 112 and subsequent at Downey and countdown for 108 and subsequent at KSC will be changed to verify that each electroluminescent segment on each digit will illuminate.

Anomaly Report

TIME: Transposition and docking

CSM-15

DESCRIPTION: The crew reported some difficulty with the turn-around maneuver after separation from the S-IVB, in that the digital autopilot would stop the manually established rotation rate each time it was activated.

DISCUSSION: The data indicate that the cause of the difficulty was procedural. In each case, the hand controller was moved out of detent after the digital autopilot was activated but before automatic control was selected in the pitch channel. Reception of an out-of-detent discrete by the computer inhibits an automatic maneuver and causes the autopilot to operate in an attitude hold mode and therefore to stop any existing rotation rate.

Aug 14, 1969

Crew Briefing

TIME: Transposition and docking

DESCRIPTION: The crew reported that the velocity reading on the entry monitor system velocity counter changed from 100.5 to 99.1 ft/sec during the 180-degree turnaround maneuver.

DISCUSSION: The average angular velocity during this maneuver was 1.75 deg/sec. The entry monitor system is mounted approximately 12 feet from the center of rotation. The resulting centripetal acceleration integrated over 180 degrees yields 1.2 ft/sec and accounts for the change observed.

Crew Briefing

TIME: (?)

DESCRIPTION: The crew reported that the mission clock in the lower equipment bay (panel 306) operated slowly and had a cracked glass. The first time it was checked after lift-off, it was 10 seconds slow. The clock was reset and the next day was 3 or 4 seconds slow.

DISCUSSION: The mission clocks have had a history of slow operation, and the cause has been electromagnetic interference. Both mission clocks on Apollo 7 and several other clocks on various vehicles have had cracked glasses. The glass is bonded to the metal outer face plate by fusing with a ceramic frit at 1100° F. A stress is induced into glass during this process, making the glass susceptible to cracking. The CCB directed that a clear, pressure-sensitive tape be placed over the glass face to preclude complete breakage.

IN PROGRESS: Per CCB direction of 8/8/69, a new mission clock is being procured. The new clock will incorporate design changes to prevent improper timing and glass breakage. This clock will be assigned to spacecraft when qualification testing is completed.

TIME: Postflight Testing

DESCRIPTION: All but one tie-wrap knots were found untied during postflight testing.

DISCUSSION: An apparent installation error on the forward heat shield mortar umbilical lanyard was found during postflight examination of Apollo 11 in that all but one of the tie-wrap knots were untied. This series of knots secures the tie-wraps around the electrical bundle and functions to break the wraps during heat shield jettison.

The knots, according to the drawing, should be two closely tied half-hitches which secure the tie-wraps to the lanyard. Examination of the Apollo 10 lanyard indicates that these knots were not two half-hitches but a clove hitch. Although the lanyard still breaks the stay ties, the knots may become undone if the broken ties pull out of the knot, thus lengthening the lanyard. If four or more knots become untied, the lanyard will be lengthened to a point which will allow the load to be carried by another lanyard which disconnects the forward heat shield drogue mortar cable. This could cause premature disconnection of the mortar cable, preventing firing of the drogue mortar, which could result in forward heat shield recontact.

Spacecraft 110 and 111 were examined, and it was found that a clove hitch was used on those vehicles also.

A step-by-step procedure for correct lanyard knot tying and installation is being developed for spacecraft 112. Spacecraft 108 and 109 will be reworked per this procedure.

ASSIGNED TO: Malley

TIME: Translunar injection

CSM-19

DESCRIPTION: The reading in the flight director attitude indicator was about 1.5 degrees different from the predicted value during the translunar injection firing.

DISCUSSION: *Per procedure, the crew must align the FDAI/ORDEAL by torquing the ORDEAL at approximately 4 deg/min while the launch vehicle is maintaining local vertical. Small errors are induced because the alignment is made while the launch vehicle is moving. Through attitude checks at specific times, these errors are reduced to 0.5 degree. The FDAI is readable to 0.25 degree. Because of the trajectory, these errors are in the direction of the FDAI error. A late trajectory modification which was not incorporated into crew procedures changed the ignition attitude by 0.4 degree. An error in the ORDEAL initialization introduced an error of 0.2 degree. The sum of the four is 1.35 degrees in the same direction reported by the crew.*

No change in procedure is planned since the present procedure has been verified in two independent simulations.

TIME: Transearth phase

DESCRIPTION: The crew reported seeing flashes of light in the command module.

DISCUSSION: A phenomenon similar to that observed by the crew has been observed during processes; however, it occurred in the 10 to 3 psia pressure range and high electrical fields. Low energy cosmic rays could possibly cause the noted effect at 5 psia. An attempt was made to simulate this effect at cabin pressure levels but without success.

An alpha particle source was used in an attempt to duplicate the light flashes at 5 psia and at 5 microns but without success. Since the alpha particle source - the highest energy source available - was unable to furnish high enough energy levels to reproduce the phenomenon, no further testing is planned.

ME: CSM separation

PROBLEM: Service module post-separation dynamics not predictable

DISCUSSION: Photographic data were obtained of the service module entering the earth's atmosphere and disintegrating near the command module. Pre-flight predictions indicated the service module should have skipped out of the earth's atmosphere and entered a highly elliptical orbit. The crew observed the service module about 5 minutes after separation and indicated the reaction control thrusters were firing and the module was rotating about the X plane.

Based on the film, crew observation of the service module, and data from previous missions, it appears that the service module did not perform as a stable vehicle following command module/service module separation. Calculations using Apollo 10 data show that it is possible for the remaining propellant to move axially at frequencies approximately equal to the precessional rate of the service module spin axis about the X body axis. This effect causes the movement to resonate, and the energy transfer between the rotating vehicle and the propellants may be sufficient to cause the service module to go into a flat spin about the Y or Z axis and become unstable.

Six-degree-of-freedom calculations, with a spring-mass propellant movement model, have been performed, and they do indicate that a trend toward instability is caused by propellant movement. Certain trends exist now which indicate that the service module could flip over as a result of propellant movement and attain a retrograde component of reaction control thrusting before going unstable. Service module separation instability is being reassessed to determine any change in the separation maneuver which may be desirable to better control the trajectory of the service module.

Calculations indicate that the roll thruster firing should be decreased from 5.5 seconds to 2 seconds and that the translation thruster firing be limited to 25 seconds. For Apollo 12 there will be no hardware or procedure changes. For Apollo 13 and subs the service module jettison controller timing will be changed.

SUMMARY LIST

LUNAR MODULE

<u>No.</u>	<u>Title</u>	<u>Status</u>
1	Mission timer stopped	Closed
2	Descent propulsion fuel pressure increase during venting	Closed
3	Inability of steerable antenna to achieve lock-on during descent	Closed
4	Circuit breaker broken during preparation for extravehicular activity	Closed
5	Carbon dioxide partial pressure high	Closed
6	Water in suits	Closed
7	Rendezvous radar temperature stable below heater activation level	Closed
8	Turnaround (echo) of ground voice during extravehicular activity	Closed
9	Master alarm at ascent stage jettison	Closed
10	Lack of voice and timing on tape from onboard recorder	Closed
11	Computer alarms during powered descent	Closed
12	Lunar module decompression time longer than predicted	Closed
13	Descent propulsion oxidizer interface pressure oscillations	Closed
14	Scattering of debris over lunar surface during ascent	Closed
15	Reaction control system chamber pressure switch failed closed	Closed
16	Apparent thermal coating cracking around docking tunnel after ascent stage jettison	Closed
17	Electroluminescent segment in data entry and display assembly numeric display failed off	Closed
18	Master alarms during checkout and surface stay	Closed
19	Wrinkled quad 4 plume deflector	Closed
20	Reaction control system B oxidizer manifold pressure oscillations	Closed
21	Relatively large alignment errors indicated by the sun check prior to powered descent	Closed
22	Unsuccessful abort guidance system alignment	Closed
23	Ascent propulsion fuel and oxidizer tank pressure decreases after ascent stage was in lunar orbit	Closed
24a	Thrust chamber warning flags prior to descent orbit insertion	Closed
24b	Master alarm when engine A2A pulsed seven consecutive times without pressure switch response	Closed
25	Crew unable to sleep because of cold cabin during lunar-surface sleep period	Closed
26	Lunar Module Pilot's voice breakup during extravehicular activity	Closed

LUNAR MODULE PROBLEM LIST

LM-1

TIME: (?)

DESCRIPTION: The crew reported that the lunar module mission timer stopped shortly after the lunar landing (103:11:13). After being de-energized for 11 hours, the timer was started again (114:30:00) and functioned normally throughout the remainder of the mission.

DISCUSSION: A review of timer failures has shown the most probable cause of failure to be a cracked solder joint. The electrical components are sandwiched between two circuit boards and the void between the boards filled with potting compound. The differential expansion between the potting compound and circuit boards causes solder joints to crack, breaking electrical contact. The 11-hour deenergized period allowed the timer to cool and the joint to make electrical contact, permitting the timer to operate. Action taken has not corrected a basic design problem, and as a result of a complete redesign, additional failures can be expected.

The timers have been subjected to several corrective actions. Joints were heavily soldered, the number of temperature cycles was reduced from four to one, and a 50-hour burn-in was added. None of these measures proved satisfactory. Also, the event timer is of similar construction and made by the same vendor. and two mission timers for the command module are also furnished to NR by GAC.

Present testing will insure the installation of timers with the highest probability of satisfactory operation. This timer is the only direct source of mission elapsed time; however, the crew can obtain time from wrist watches, the event timer, and DSKY (noun 65).

IN PROGRESS: *Per CCB direction, new mission timers and event timers which will be mechanically and electrically interchangeable with present timers will be procured. These new timers will use integrated circuits welded on printed circuit boards instead of the cordwood construction. This type construction has been successfully used on other devices. The new timers will be used when qualification testing is complete.*

ASSIGNED TO: Kingsley, GAC

Crew Briefing/Anomaly Report

LUNAR MODULE PROBLEM LIST

TIME: Propellant venting

LM-2

DESCRIPTION: During propellant venting after landing, the fuel interface pressure increased rapidly to an off-scale reading. The fuel line froze during venting of the supercritical helium, trapping fuel between the pre-valve and the helium heat exchanger and causing the pressure rise.

DISCUSSION: Checklist changes *have been incorporated* to vent the propellant tanks to 20 to 40 psia after landing, with the helium isolation solenoid valve closed. The helium isolation solenoid valve will then be opened, venting the supercritical helium tank just before lift-off.

TIME: Descent

LM-3

DESCRIPTION: During descent, the steerable antenna did not lock-on to the ground station. Reacquisition was unsuccessfully tried several times prior to powered descent. Proper acquisition was obtained after the yaw maneuver.

DISCUSSION: Errors were discovered in the antenna coverage restriction diagrams in the Spacecraft Operation Data Book for the pointing angles used. The diagram had not been updated to include the thruster plume deflectors, which were added to the lunar module at the launch site. An update of the blockage diagram indicates that the pointing angles of the antenna were in an area of blockage or sufficiently close to blockage to affect the coverage pattern. As the antenna boresight approaches vehicle structure, the on-boresight gain is reduced, the selectivity to incoming signals is reduced, and side-lobe interference is increased.

In addition, a study was performed to determine the effects of a multipath signal, or reflected signal from the lunar surface for the actual vehicle flight trajectory. The study indicates that the multipath signal alone would be sufficient to cause some of the antenna tracking losses. Further, the reduction in antenna selectivity caused by vehicle blockage increases the probability of multipath interferences in the antenna tracking circuit.

Conclusions are that vehicle blockage and multipath signals combined to create the problem. The nominal performance of the steerable antenna before and after the time in question indicates that the antenna did not fail.

The steerable antenna coverage plot has been updated to more accurately define structure blockage areas and the structure clearance guard band requirements. *In addition, the following changes have been incorporated into the Apollo 12 and subsequent checklists:*

- a. Approach acquisition settings with CCW motion
- b. Delete reference to peak strength meter
- c. Verify strength meter reading 3 or greater without peaking.

Also, the simulators are being modified to add antenna sidelobes and servo backlash to provide more realistic crew training. These modifications should be completed by October 15.

LUNAR MODULE PROBLEM LIST

TIME: 112 Hours

DESCRIPTION: The crew reported that the knob on the ascent engine arm circuit breaker was broken. The aft edge of the oxygen purge system probably hit the breaker during preparations for extravehicular activity, causing the breakage. Also, two other breakers were pushed on.

The circuit breaker was closed without difficulty when it was required prior to ascent.

DISCUSSION: The CCB directed that all lunar module circuit breakers will be guarded, effective on LM-6 and subsequent. The present guards attach to the circuit breaker panels using the circuit breaker bushings as attach points. A test was performed which showed that impact loads on the guard will crack the circuit breaker housings. The loads tend to pull the bushings out of the circuit breaker housing. The CCB subsequently directed that for Apollo 12 and 13, the guards on the top tier of circuit breakers be removed. For the remaining guards, compression struts will be added from the guard to the panel face to remove loads caused by impact from the circuit breaker bushings.

Tests showed that guards with compression struts can still damage the circuit breakers when subjected to impact loads. Consequently, guards which do not use the circuit breaker shanks for mounting are being installed in Apollo 12 and subsequent. The new guards are bonded to the panel.

TIME:

126 Hours

LM-5

DESCRIPTION: Carbon dioxide partial pressure read high. The crew selected the secondary lithium hydroxide canister, and readings were still erratic. The primary canister was again selected, and the caution and warning alarm was activated. The carbon dioxide sensor was then deactivated to stop the alarms.

DISCUSSION: Erratic operation in the past has been caused by free water in the optical section of the sensor. Prior to extravehicular activity, the environmental control system was deactivated. This stopped the water separator and caused the collected condensate (72 ml maximum) to dump into a drain tank. The vent for this tank is connected upstream of the carbon dioxide sensor. If the honeycomb material in the tank did not retain the water, the water could have been introduced into the sensor. The CCB approved a design change relocating the drain tank vent to an existing boss upstream of the fans, effective on LM-7.

Anomaly Report

TIME: 126 hours

LM-6

DESCRIPTION: The Commander reported water in his suit after lunar lift-off.

The following discussion was taken from the 30-Day Failure and Anomaly Listing:

"After the lunar module achieved orbit, water began to enter the Commander's suit in spurts (estimated to be 1 tablespoonful) at about 1-minute intervals. The Commander immediately selected the secondary water separator, and the spurts stopped after 15 to 20 minutes. The spurts entered the suit through the helmet end duct when the crew were not wearing their helmets. The pressures in all liquid systems which interface with the suit loop were normal, indicating no leakage.

"The possible sources of free water in the suit loop are the water separator drain tank, an inoperative water separator, local condensation in the suit loop, and leakage through the water separator selector valve. An evaluation of each of these possible sources indicated that leakage through the water separator selector valve was the most probable source of the free water.

"The valve is a flapper type which is located in a Y-duct arrangement and is used to select one of two water separators. Leakage of this valve would allow free water to bypass through the idle water separator and subsequently enter the suit hose. This leakage most probably resulted from a misalignment and binding in the slot of the selector valve actuation linkage. The allowable actuation force after linkage rigging was 15 pounds. The usual actuation forces have been 7 to 8 pounds, but 12.5 pounds was required on Apollo 11. *For LM-6 and subsequent, the allowable actuation force has been lowered to 10 pounds, and inspections for linkage binding have been incorporated into procedures at the factory and the launch site.*"

TIME: 101-1/2 Hours

IM-7

DESCRIPTION: At loss of signal just prior to descent orbit insertion, the rendezvous radar temperature was 17.8° F. The heater activation temperature was thought to be 26° F. When the signal was acquired at 102 hours, the temperature was 46.6° F. This increase would not be expected based on the thermal model, *acceptance test procedure data*, and flight plan.

DISCUSSION: *The acceptance test procedure is run using a thermocouple attached to the thermostat. The flight instrumentation transducer is located several inches from the thermostat. The thermal math model reflects the thermostat location, not the instrumentation transducer location.*

IN PROGRESS: The math model is being changed to include the *instrumentation transducer location*.

Aug 14, 1969

TIME: Extravehicular activity

LM-8

DESCRIPTION: A voice turnaround (echo) was heard during extravehicular activity. At that time, the lunar module was operating in a relay mode. Uplink voice from the S-band was processed and retransmitted to the two extravehicular crewmen via the lunar module VHF transmitter. Crew voice and data were received by the lunar module VHF receiver and relayed to the earth via the lunar module S-band transmitter.

DISCUSSION: The echo was duplicated in the laboratory and resulted from acoustical coupling between the communications carrier earphone and microphone. Turnaround could not be produced when the earphones were disconnected. Postflight, the crew indicated that the volume controls on the extravehicular communications systems were set at maximum during the extravehicular activity. This setting would provide a level of approximately plus 16 dBm into each crewman's earphones. Acoustical isolation between earphones, exclusive of air path coupling, is approximately 48 dB. The ground voice signal would therefore appear, at the microphone output, at a level of approximately minus 32 dBm. Assuming extravehicular communication keying is enabled, this signal would be processed and transmitted by the extravehicular communications system and would provide a level of approximately minus 12 dBm at the output of the lunar module VHF receiver. If the lunar module relay is enabled, this signal would be amplified and relayed to earth via S-band at a nominal output level.

When the lunar module voice-operated keying circuit is properly adjusted, any signal that keys the extravehicular communications system will also key the lunar module relay. There are indications that the lunar module voice keying sensitivity was set below maximum, as evidenced by the relayed voice breakup experienced by the Lunar Module Pilot. It would have, therefore, been possible for the extravehicular communications system to be keyed by breathing or suit air flow without this background noise being relayed by the lunar module. The uplink turnaround voice could, however, provide the additional lunar module received audio signal level to operate the voice-operated keying circuits, permitting the signal to be returned to the earth. Postflight, the crew indicated that the voice-operated keying circuits in the extravehicular communications system were activated by suit air flow for some positions of the head in the helmet. Both voice-operated keying circuits were also keyed by bumping or rubbing of the communications carrier against the helmet. Because there does not appear to be any practical way to eliminate random voice keying or significantly reduce acoustical coupling in the communications carrier, the random echo problem is inherent in the communication system design.

Downlink muting capability is being added to the primary and secondary CAPCOM and the PAO networks to eliminate the echo if it becomes objectionable.

Anomaly Report

LM-9

TIME: Lunar module jettison

DESCRIPTION: A master alarm was noted at lunar module jettison (130:09:39).

DISCUSSION: The alarm was caused by an apparent rise in carbon dioxide partial pressure; the indicated rise resulted from free water in the carbon dioxide sensor (see LM-5).

IN PROGRESS: No action is required.

The following anomaly was closed but is included in this list to show corrective action.

TIME: Lunar module operations

IM-10

DESCRIPTION: The data storage electronics assembly did not record properly in flight. Postflight playback of the tape revealed that the reference tone was recorded properly; however, the voice signal was very low and recorded with a 400-hertz tone and strong background noise. Occasionally, the voice level was normal for short periods. In addition, only the 4.2-kilohertz timing signal was recorded. This signal should have switched between 4.2 and 4.6 kilohertz to record the timing code.

DISCUSSION: During postflight tests, the recorder functioned properly for the first 2 hours of operation. Then, the voice channel failed, recording no voice or background noise, although timing and reference tones were recorded properly. This failure does not duplicate the flight results, indicating that it did not exist in flight.

Tests were run with the recorder installed in a lunar module to determine what vehicle wiring failures could cause the signals found on the flight tape. These tests showed that only opening both the timing signal return line and the voice signal line would duplicate the problem. Therefore, the cause was probably two broken wires (26 gage) at the vehicle harness connector which plugs into the recorder. Similar broken wires were found in LTA-8 during thermal/vacuum tests. *For LM-6 and subsequent, the wire harness at the recorder connector has been wrapped with tape to provide stiffness and protection against flexure damage.*

Preflight data show that both the timing inputs and the internally generated reference frequency were out of vendor specification. These measurements may be indicative of a preflight problem with the system. Unfortunately, this condition was not recognized because of inadequacies in the procedure. *The procedure has been corrected for LM-6 and subsequent.*

The recorder was returned to the vendor, where the intermittent voice problem was traced to a bad weld in the audio amplifier output trim pot. This failure is not related to the flight problem, since there is no background noise with the 400-hertz signal on the tape during the failure. The failed pot is on the output side of the audio amplifier and therefore could not have been damaged by an overload on the input due to the flight problem. The bad pot was replaced, and the recorder successfully completed the acceptance test.

TIME: Powered descent

LM-11

DESCRIPTION: Five computer alarms occurred during the powered descent phase. All were of the executive overflow type, indicating that the computer was overloaded.

DISCUSSION: The overload was caused by an excessive number of inputs from the rendezvous radar coupling display units. The rendezvous radar was powered up but not being used for descent guidance; therefore, the radar mode switch was not in the LGC position. In this configuration, the rendezvous radar antenna angle resolvers are provided an 800-Hz, 28-volt reference voltage from the attitude and translation control assembly. The coupling data units, which receive and digitize the resolver outputs, use an 800-Hz, 28-volt reference supplied by the computer which is frequency- but not phase-locked to the attitude and translation control assembly reference. Phase and amplitude differences between those references will cause the coupling display units to oscillate and transmit an abnormal number of angle pulses to the computer. Each pulse received by the computer causes an interrupt and reduces the available computation capability. During powered descent, the computer workload is normally heavy, and the angle inputs apparently caused an overload. Despite the alarms, all guidance and control functions were performed as planned.

Program Change Request 848 has been approved calling for a software fix as follows: A computer input channel discrete which is set by the radar mode and power configuration will be monitored as part of the executive routine. When the radar is not powered up or not in the computer mode, the coupling display units will be zeroed, removing any possibility of extraneous inputs.

Crew Briefing/Anomaly Report

TIME: 109 Hours

LM-12

DESCRIPTION: Decompression of the lunar module cabin required longer than predicted.

DISCUSSION: A review of the data indicates that the cabin pressure transducer was reading high at the low end of its range; therefore, the crew could have opened the hatch sooner had the true pressure been known.

Based on crew debriefing, it is believed that the crew probably opened the hatch as soon as practical, even though the pressure gage was reading high at the low range.

An analysis has shown that the hatch cannot be permanently deformed by attempts to open it with the cabin pressure too high. Analysis shows that the hatch handle will break at a pull of 180 pounds, whereas 240 pounds is required to permanently deform the hatch. Static tests were conducted to determine the handle forces required to deflect the hatch sufficiently to permit air flow past the seal. Results show that a handle force of 78 pounds is required at 0.2 psid and 118 pounds is required at 0.35 psid. The hatch deflected only in the area of the handle. In addition, tests showed that suited subjects in one-g could pull only about 50 pounds maximum.

On LM-6 and subsequent vehicles, the bacteria filter will not be used, thus reducing the time for decompression from about 5 minutes to less than 2 minutes. *The Apollo Operations Handbook has been changed establishing both a time limit and a pressure reading at which hatch opening may take place. Also, the altitude chamber test for LM-7 included a partial cabin vent which verified satisfactory valve operation without the bacteria filter installed.*

TIME:

Powered descent

IM-13

DESCRIPTION: During the powered descent maneuver, the descent propulsion oxidizer interface pressure appeared to be oscillating up to 20 psi peak. These oscillations were evident throughout the maneuver; however, they were the most severe at about the 50-percent thrust level.

DISCUSSION:

The high sample rate data was reviewed. The analysis indicates amplitudes up to 67 psi peak-to-peak and frequencies above 200 Hz. No unusual oscillations were observed in other system measurements. The oxidizer interface pressure oscillations were caused by pressure transducer resonance resulting from trapped gas in the transducer line. These type oscillations have been observed in tests at White Sands and are no problem to system operation. They may occur randomly on future flights.

COMPLETION: August 15

ASSIGNED TO: Hammock, GAC

TIME: Lift-off from lunar surface

LM-14

DESCRIPTION: Debris (thermal insulation) were detached and scattered over the lunar surface during ascent. Also, the passive seismic experiment has been experiencing temperatures at lunar noon approximately 50° F higher than anticipated (190° versus 140° F), indicating possible degradation of the thermal control surfaces of the experiment.

DISCUSSION: A considerable amount of debris consisting of pieces of the thermal shield and blanket was detached from the top deck of the descent stage during lunar module ascent. This was expected since several fire-in-the-hole ground tests conducted at White Sands indicated this would occur. The debris could cause problems with experiments deployed on the lunar surface if debris were to fall on them.

On future missions, the Apollo Lunar Surface Experiments Package will be deployed on the lunar surface; however, it will be deployed at a distance of 300 feet or more from the lunar module, thereby greatly decreasing the possibility of debris falling on it. In addition, degradation of the top surface of the Apollo Lunar Surface Experiments Package central station (sunshield) does not appreciably affect its performance.

TIME: Powered descent

LM-15

DESCRIPTION: The chamber pressure switch in reaction control engine B1D failed closed at 102.41 36.8 (approximately 8.5 minutes after powered descent initiation). The switch remained closed for 2 minutes 53 seconds, then opened and functioned properly throughout the remainder of the mission.

DISCUSSION: The failure mode is believed to be the same as that of pressure switch failures on Apollo 9 and 10; that is, particulate contamination or propellant residue holding the switch closed. The only consequence of the failure was the inability to detect an engine failed "off."

TIME: Lunar module ejection

DESCRIPTION: After lunar module ejection, the crew reported seeing what appeared to be cracks in the thermal shield around the docking tunnel. No photographs were taken.

DISCUSSION: Photographs of LM-5 closeout, transposition and docking, and rendezvous, and LM-4 jettison were examined and shown to the crew. In addition, photographs from scale-model lighting simulations were also examined. Typical lunar module jettison wrinkles in the thermal shield pointed out by the crew in the LM-4 photographs would, with the sun angles during the LM-5 jettison, give the appearance of the cracks described.

TIME: Lunar module checkout

LM-17

DESCRIPTION: An upper-left electroluminescent segment on the data entry and display assembly numerical display was out during initial checkout. With this segment inoperative, a number 3 and a number 9 appeared the same.

DISCUSSION: A search of the associated failure history has not identified a similar failure. Only one previous failure of an electroluminescent segment was noted. This failure occurred during delta qualification tests, and the segment was intermittent prior to its failure. The failed Apollo 11 segment was from the same lot as Apollo 9 and 10, which both performed satisfactorily.

A Test Change Notice *has been issued* to verify the segment light intensity from full dim to full bright position, one time, at KSC prior to each respective countdown demonstration.

TIME: Lunar module checkout and lunar surface stay

LM-18

DESCRIPTION: A number of reports of red flags and caution and warning alarms were received during the above periods. All occurred with the reaction control and/or control systems deactivated and are considered normal for the given configuration.

TIME: Extravehicular activity

DESCRIPTION: The crew mentioned that the quad 4 reaction control system plume deflector appeared to be wrinkled.

DISCUSSION: A review of photographs taken on the lunar surface has revealed that no problem exists.

TIME: 125 Hours

LM-20

DESCRIPTION: Reaction control system oxidizer manifold pressure in system B oscillated between 110 and 260 psia.

DISCUSSION: This oscillation is normal. System tests performed in 1967 simulated a LM-1 mission duty cycle. The system B oxidizer manifold pressures were as low as 86 psia but were usually no lower than 120 psia. They were as high as 329 but usually no higher than 235 psia.

TIME: Prior to powered descent initiation

LM-21

DESCRIPTION: The crew reported concern over the relatively large alignment errors indicated by the sun check performed prior to powered descent. The readings taken were 0.19, 0.17, and 0.11 degree. These are near the go/no-go value of 0.25 degree; however, the optics bias for the near descent was 0.07 degree, and when considered, reduces the measured misalignments to more acceptable levels of 0.12, 0.10, and 0.04 degree.

Crew Briefing

TIME: Lunar module checkout

DESCRIPTION: The initial abort guidance system alignment was performed early and reported to be unsuccessful.

DISCUSSION: The abort guidance system is aligned in flight by transferring gimbal angles from the primary guidance system and, from these angles, establishing a direction cosine matrix. Prior to each alignment, the primary system coupling data units must be zeroed to insure that a set of angles accurately reflecting the gimbal angle is used in the alignment.

Failure to zero the coupling display units could cause the symptoms reported. *An incorrect ORDEAL switch setting could have caused a misalignment in the pitch axis. If the ORDEAL mode switch is set to "ORB RATE," the pitch angle will be offset by an amount dependent on the setting of the ORDEAL resolver - even if ORDEAL is powered down. The power-up checklist correctly calls for positioning this switch to the "INERTIAL" position.* Hardware or software malfunctions are unlikely because of the success experienced in all subsequent alignments. No data are available for the alignment attempt, and no amplifying information is contained in the data before and after the occurrence.

ASSIGNED TO: Hanaway

TIME: Post-lunar ascent

DESCRIPTION: The ascent propulsion system oxidizer and fuel tank pressures decreased 6 and 4 psi, respectively, without an accompanying temperature change. All pressures, however, were within normal specification limits at all times.

DISCUSSION: *This occurrence can not be explained by any single phenomenon. It is possible that a combination of ullage gas cooling, pressure transducer drift resulting from engine heat soakback, and errors in the PCM system may have combined to produce the observed pressure drops. In any event, the drops had no effect on the ascent propulsion system performance.*

TIME: 100 hours

IM-24a

DESCRIPTION: The crew reported thrust chamber assembly warning flags on the isolation valve talkbacks for engine pairs 2A, 4A, and 4B.

DISCUSSION: The 2A and 4A flags occurred simultaneously during lunar module station-keeping prior to descent orbit insertion. The 4B flag appeared shortly thereafter. The crew believed that these flags were accompanied by master alarms. The flags were reset by cycling of the caution and warning electronics assembly circuit breaker. The flags could not be removed by tapping the control panel.

Possible causes are:

- a. Jet driver commands given without accompanying thrust chamber pressure switch responses.
- b. One of the 16 engine-on combinations caused a thrust chamber-on failure indication.
- c. Erroneous caution and warning system or display flag operation.

Analysis of data could not confirm any of the master alarms or conditions reported before landing. Only low-bit-rate data are available for the first 4 minutes of station-keeping, and high-bit-rate data during periods prior to powered descent are too noisy to be usable. One single-point failure in the caution and warning system could cause the reported flags. *Ten of the sixteen engine pressure switch outputs are conditioned by the ten buffers in one module in the signal conditioner electronics assembly. This module is supplied with +28 V dc via one wire. The buffer module also contains an oscillator. If either the +28 V dc is interrupted or the oscillator fails, none of the ten buffers will respond to pressure switch closures. If engines monitored by these buffers are then commanded on, the corresponding warning flags will come up and a master alarm will occur.*

Review of permissible engine firing combinations has shown that if this failure occurred momentarily and simultaneous plus roll (jets A2D and B1D) and plus yaw (jets A4R and B2L) rotations were commanded, flags 2A and 4A only would have occurred. Other command combinations also exist which would give the same results. The subsequent 4B flag could then have been caused by a commanded two-jet yaw rotation (jets B4F and A2A). It also may have been a repetition of the 4B flag which occurred at 126 hours and which was caused by a sluggish pressure switch.

The signal conditioner electronics assembly failure history shows no similar failure. No corrective action is considered practical for the postulated failure.

TIME: 126-1/2 Hours

DESCRIPTION: A master alarm was noted at 126 hours 44 minutes when seven consecutive pulses were commanded on engine A2A without a pressure switch response.

DISCUSSION: Data show no response to engine A2A commands starting at 126:26:50. A master alarm was noted at the time the seventh consecutive pulse occurred without pressure switch response (126:44:27). This would have given a 2A red TCA flag on the console. The caution and warning electronics assembly circuit breaker was reset at 126:44:39, which cleared the TCA warning flags.

The pressure switch did begin responding thereafter to commands, although sluggishly with a few pulses missed altogether. The pressure switch had also responded sluggishly earlier in the flight. The performance of engine A2A was nominal before and after the occurrence. The pressure switch probably was affected by contamination. The engine performance was nominal.

ASSIGNED TO: Ferguson, GAC

Crew Briefing

TIME: Sleep period on lunar surface

LM-25

DESCRIPTION: The crew reported that they were too cold to sleep during the sleep period on the lunar surface.

DISCUSSION: The CCB has directed that hammocks be added to allow the crew to sleep off the vehicle floor and that passive blankets will be carried to give additional heating capability beyond that available from the environmental control system. *In addition, opaque window shades have been added to LM-6 to reduce ambient light conditions.*

TIME: Extravehicular activity

DESCRIPTION: Voice-operated relay (VOX) operation during extravehicular activity caused breakup of voice received by the Network. This breakup was primary associated with the Lunar Module Pilot.

DISCUSSION: In ground tests, by decreasing the sensitivity of the voice-operated keying circuits from 9 to 8, the conditions that was characteristic of the problem experienced during the extravehicular activity was duplicated (*decrease of 7 dB*). The crew indicated that the pre-extravehicular activity adjustment should have been set in accordance with the onboard checklist (maximum increase). The crew also verified that they did not experience any voice breakup between each other or from the Network, and this indicates that the breakup was probably caused by marginal keying of the lunar module downlink relay voice-operated keying circuits.

Ground tests were also performed using voice tapes obtained of the Apollo 11 crew during altitude chamber tests in an attempt to duplicate the problem by simulating voice modulation characteristics and levels being fed into the lunar module communications system during the extravehicular activity. These voice tapes modulated a signal generator which was received by and relayed through a breadboard of the lunar module communication system. There was no discernible breakup of the relayed voice with the sensitivity control set at 9.

All analysis and laboratory testing to date indicates that the voice breakup experienced during the extravehicular activity was not an inherent system design problem. Testing has shown that any voice which will key the extravehicular communication system will also key the lunar module if the sensitivity control is set at 9

The most probable cause of the problem is an inadvertent low setting of the Commander's sensitivity control. Other less likely causes are degraded modulation from the extravehicular communications system or degradation of the lunar module circuit gain between the VHF receiver and the Commander's amplifier. However, no known previous failures which resulted in degraded extravehicular communication modulation levels or degraded lunar module keying sensitivity.

IN PROGRESS: *Tests are being planned at KSC to demonstrate satisfactory interface performance between the EVC and the LM-6 Spacecraft. The Apollo 12 crew will be briefed on setting of the lunar module VOX controls.*

COMPLETION: August 19

ASSIGNED TO: Kingsley, Kyle

Crew Briefing/Anomaly Report

SUMMARY LIST

GOVERNMENT-FURNISHED EQUIPMENT

<u>No.</u>	<u>Title</u>	<u>Status</u>
1	Command Module Pilot's respiration rate signal ceased	Closed
2	See LM-26	
3	Passive seismic experiment leveling	Closed
4	Difficult to align lunar surface closeup camera	Closed
5	Awkward to implement lunar equipment conveyor	Closed
6	Rock boxes were difficult to handle and close on descent stage work table	Closed
7	Television camera cable retained coiled shape, providing loops to catch crewmen's feet	Closed
8	Crew uncomfortably warm in biological isolation garments	Closed
9	Difficult to mate electrical connector from remote control unit to portable life support system	Closed
10	Contingency sample pocket on Commander's leg located too close to abort handle during launch	Closed
1	Wrist rings rubbed Lunar Module Pilot's wrists and Commander's hands were moist	Closed
12	Crew requested that inflight coverall garment be made like a one-piece summer flight suit	Closed
13	Command Module Pilot recommended fitting pressure garment, liquid-cooling garment, urine collection and transfer assembly, and fecal containment assembly together prior to flight	Closed
14	Attachment of urine transfer system to Lunar Module Pilot's integrated thermal and micrometeoroid garment loosened	Closed
15	Helmet identity is confused after removal from stowage bags	Closed
16	Lunar Module Pilot's restraint harness pulled him to the right	Closed
17	Commander had difficulty mounting 70-mm Hasselblad lunar surface camera on remote control unit	Closed
18	Medical accessory kit was difficult to remove from stowage compartment	Closed
19	Crew found ear plugs uncomfortable to wear	Closed
20	Core tubes difficult to drive into lunar surface	Closed
21	Core tube problems a. Caps nearly discarded with net packing during unstowage b. One follower clip missing; one upside down; one split core tube liner out of register c. One quick disconnect plug inadvertently left on lunar surface	Closed
22	<i>Liquid cooling garment leaked during postflight testing</i>	<i>Closed</i>

GOVERNMENT-FURNISHED EQUIPMENT

TIME: 179 Hours

GFE-1

DESCRIPTION: The signal from the impedance pneumograph (respiration rate) for the Command Module Pilot was lost. The crew was advised to check connectors and try new paste.

DISCUSSION: There is no evidence that the Command Module Pilot tried new paste. Problem is believed to be paste dryout. The doctors agree that the problem could have been solved by use of one of the spare harnesses or by application of new paste.

NOTE: GFE-2 was moved to LM-26.

GFE-2

GOVERNMENT-FURNISHED EQUIPMENT

TIME: Lunar surface activity

GFE-3

DESCRIPTION: The crew had difficulty levelling the passive seismic experiment using the ball with quartz dish indicator (low damping). Levelling the laser ranging retro-reflector with a liquid-damped bubble level indicator was much easier. The seismic experiment package is deployed as a separate unit on later missions, is thus much smaller overall, and is more easily levelled. This problem was peculiar to the Apollo 11 configuration.

DISCUSSION: *The CCB has approved a liquid-damped bubble level indicator for use in levelling the seismic experiment on Apollo 12 and subsequent. Thus, the seismic experiment package with its new level indicator and easier handling capabilities will not present a levelling problem to Apollo 12 and subsequent missions.*

TIME: Lunar surface activity

DESCRIPTION: The lunar surface closeup camera was difficult for the crew to transport and align with some objects to be photographed because of camera handle configuration. It was difficult to place the camera in such a position as to keep it from falling over when not in use. Lunar surface conditions make it difficult to determine true vertical.

In addition, full travel of the trigger requires more effort than desired.

DISCUSSION: Modifications to the closeup stereo camera to eliminate operational difficulties were approved by the CCB, effective on Apollo 12 and subsequent. The modifications consist of:

- a. Trigger force reduced to a suitable level
- b. A plate added to the bottom of the camera on the cut-away side to preclude tipping problems
- c. Handle will be hinged for correct angle adjustment for LM-7 and subsequent (also for LM-6 if modification is completed in time for Apollo 12).

GOVERNMENT-FURNISHED EQUIPMENT

TIME: Lunar surface activity

GFE-5

DESCRIPTION: The lunar equipment conveyor was awkward to implement under 1/6-g and lunar soil conditions. Easier than expected crew mobility on the lunar surface resulted in the crew suggesting the use of technique of simple hand-over-hand tether lifting from the porch.

DISCUSSION: The Apollo 12 crew considered the following systems:

- a. The lunar equipment conveyor system used on Apollo 11, with or without the teflon rollers
- b. A single-strand version of the conveyor
- c. Use of the waist tether drawn over the handrails
- d. a or b, with c as a backup.

They recommended the use of the single-strand version of the conveyor for Apollo 12, together with some trial lifts with the tethers over the handrails. The CCB has approved the recommendation.

GOVERNMENT-FURNISHED EQUIPMENT

TIME: Lunar surface activity

GFE-6

DESCRIPTION: Rock boxes were difficult to handle and close on the descent stage work table.

DISCUSSION: A technique for burnishing on the lubricant after cleaning has been incorporated. As a result, containers now being delivered have closing forces no greater than 25 pounds.

For Apollo 12, a set of special bungees, to attach the rock boxes to the table while in use, have been installed on the Cape mockup for review during the week of October 6. If satisfactory, these will be used on Apollo 12; otherwise, retention will be accomplished by the method of handling the boxes by the crew.

TIME:

Lunar surface activity

GFE-7

DESCRIPTION: The cable for the lunar surface television camera retained its coiled shape on the lunar surface when deployed, providing loops to catch on crewmen's feet.

DISCUSSION: MSC, Westinghouse, and GAC have investigated the following possibilities to alleviate the cable loop problem:

- a. Cable material changes
- b. Deployment procedures including use of lunar rocks for securing the cable to the lunar surface
- c. Modification of stowage and deployment hardware for the spacecraft.

The results of this investigation indicate only minimal improvement and with a 2-pound weight penalty. The CCB has directed that no hardware change will be made for Apollo 12.

GOVERNMENT-FURNISHED EQUIPMENT

TIME: Recovery

DESCRIPTION: During recovery, the crew were uncomfortably warm in biological isolation garments, the nose and mouth cup fit was poor on two of them, and the visor fogged up excessively on two.

DISCUSSION: Suits are qualified for 2 hours with no harmful effects. The Apollo 11 crew was in biological isolation garments for approximately 40 minutes, including pickup, helicopter transfer to ship, helicopter onboard to mobile quarantine facility. Maximum range for the helicopter could add about 30 minutes flying time.

Recovery tests in the Gulf of Mexico of 2-hour and 4-hour duration indicated that one can expect to become uncomfortably warm within a short time but that the condition will stabilize in about an hour (uncomfortable but not dangerous).

Chamber tests on three subjects at 90° F and 95% RH showed that, with a loose face mask, the visor begins to fog considerably within 5 minutes, and the subject becomes noticeably uncomfortable; whereas, when the face mask is drawn up tight, the visor remains clear throughout the test and only minimal discomfort is experienced.

In accordance with the decision of the ICBC meeting of Oct. 30, 1969, the prime garment for the Apollo 12 crew will be a respirator and the standard NASA Book Flight Coveralls, which will be placed inside the CM by a swimmer, and donned by the crew inside the CM. A set of biological isolation garments will be provided in the recovery area, to be used only in case a requirement develops during the transearth and entry phases.

TIME: Prior to extravehicular activity

GFE-9

DESCRIPTION: The crew reported difficulty mating the electrical connector from the remote control unit to the portable life support system.

DISCUSSION: This connector requires exact alignment and a moderate insertion force before the locking ring can be engaged. Further, other common problems can arise associated with making of electrical connections, like bent pins and debris in socket (the lunar module in flight is far from a clean room), which can cost a mission.

The remote control unit can be stowed for launch attached to the portable life support system that is located on the left hand side of the cabin midsection. To do this, a structural strengthening of the portable life support system mounting provisions would be required, and the remote control unit will slightly encroach upon the Commander's mobility envelope. For the portable life support system that is stowed on the floor at launch, there is no way to attach the remote control unit without fabricating a new floor or making some other provisions which would raise the portable life support system off the floor by approximately 3 inches.

The CCB has approved the recommendation of Crew Systems Division to replace the male half of the Bendix connector with a Deutsch. The design of the Deutsch differs from the Bendix and greatly improves the mating capability.

TIME: Launch

GFE-10

DESCRIPTION: The location of the contingency sample pocket on the Commander's leg placed it too close to the abort handle.

DISCUSSION: The Commander had the contingency sample pocket strapped on his leg in a position for convenient access. It was found that with the pocket strapped in this position, with the pocket stiffener in place, and with the couch in the launch position, the pocket was very close to the abort handle. Since this pocket can be strapped to either the upper or lower, right or left leg, the Commander recommended that the location of the abort handle be considered when future crews select the location of the pocket. The pocket is strapped on just prior to ingress and can be adjusted subsequently.

TIME: Lunar surface activity

GFE-11

DESCRIPTION: The wrist rings rubbed the Lunar Module Pilot's wrists and the Commander's hands were moist.

DISCUSSION: Wristlets and comfort gloves were taken along for the Commander and Lunar Module Pilot for optional use during the lunar stay. Because of the quick adaptation to 1/6-g, the light loads handled, and the short duration of the lunar surface activity, both crewmen elected to omit the use of the wristlets and gloves. Preflight training had included training with these items. Without the protection of the wristlets, the wrist rings rubbed the Lunar Module Pilot's wrists, and the grasp capability of the Commander was reduced without the comfort gloves. The crew recommended the use of both for future missions. The use is a crew option.

TIME: Crew debriefing

GFE-12

DESCRIPTION: The crew requested that the inflight coverall garment be made like a one-piece summer flight suit.

DISCUSSION: The crew recommended that the inflight coverall garment would be more utilitarian if made of qualified material, but otherwise patterned after the one-piece summer flight suit. This is being done for Apollo 13 and subsequent and for Apollo 12 if possible. The prototype unit has been made and is being evaluated.

TIME: Crew debriefing

GFE-13

DESCRIPTION: The Command Module Pilot recommended fitting the pressure garment, liquid-cooling garment, urine collection and transfer assembly, and fecal containment assembly together prior to flight.

DISCUSSION: The Command Module Pilot had a fit problem in the lower abdomen and crotch area of his pressure garment assembly, which had been fitted to him before his operation. In addition, he recommended that future crews be fit checked wearing the liquid-cooling garment, urine collection and transfer assembly, and fecal containment assembly. This is being implemented for Apollo 12 and subsequent.

TIME:

Lunar surface activity

GFE-14

DESCRIPTION: The attachment of the urine transfer system to the Lunar Module Pilot's integrated thermal and micrometeoroid garment loosened.

DISCUSSION: The urine transfer system fitting loosened in the clamp in the Lunar Module Pilot's integrated thermal and micrometeoroid garment. He aligned the fitting, reinserted it in the clamp, and made the external hose connection satisfactorily. The preinstallation acceptance procedures incorrectly specified torquing the clamp screw to 2 to 3 in-lb. This has now been corrected to the proper torque of 5 to 7 in-lb. *Ground tests have confirmed that this torque will hold the fitting securely.*

TIME: Crew debriefing

GFE-15

DESCRIPTION: Helmet identity is confused after removal from stowage bags.

DISCUSSION: Since the interim stowage of the helmets in the lunar module is not in identified helmet stowage bags, the crew recommended that the helmets be properly identified. For Apollo 12 and subsequent, the appropriate identification is to be marked in compatible ink on the vent pad of each helmet at the time of preinstallation acceptance.

TIME:

Lunar module operations

GFE-16

DESCRIPTION: The Lunar Module Pilot's restraint harness pulled him to the right.

DISCUSSION: The Lunar Module Pilot reported a pressure point on his right foot resulting from the lunar module restraint harness pulling him to the right. The harness is configured for the Commander and the Lunar Module Pilot to be positioned in the same location on opposite sides of the cabin. The Commander operates primarily in the design location in front of the left hand window. On the other hand, the Lunar Module Pilot not only operates in a comparable position on the right hand side, but also works a great deal with the center console, and so the restraint system tends to pull him to the right, away from this functional area. The force of this pull can be reduced by a bench modification to the Lunar Module Pilot's restraint spring adjustment components. A change in the center of the restraint positioning would be a much more extensive project. No change is planned for Apollo 12. Restraint spring force adjustment is a crew option.

TIME: Lunar surface activity

GFE-17

DESCRIPTION: The Commander had difficulty in mounting the 70-mm Hasselblad lunar surface camera on the remote control unit.

DISCUSSION: The installation of the camera assembly (camera, trigger, remote control unit adapter, and handle) on the remote control unit mounting bracket is a lunar surface activity and is rather awkward in that it requires the crewman to lean backward far enough for the camera assembly to clear his helmet and visor as he starts the sliding fit of the camera assembly onto the bracket.

Making the camera assembly steady and secure is a bare hand activity in the lunar module before egress, and it requires the tightening of a single screw which holds the camera, trigger, adapter, and handle together.

Apollo 12 training with the installation of the camera assembly on the remote control unit has been satisfactory. *The head of the clamping screw has been modified for Apollo 12 for tighter clamping.*

TIME: Crew debriefing

GFE-18

DESCRIPTION: The medical accessory kit was difficult to remove from the stowage compartment.

DISCUSSION: The Command Module Pilot found it necessary to cut away the lower half of the left hand flap of the medical accessory kit to get the kit past the two fasteners attached to the left hand wall of the stowage compartment. These fasteners have been removed from spacecraft 108 and subsequent; the Engineering Order was too late for spacecraft 107.

CLOSED

Sealed packages of Band-aids, etc., were vented before being stowed in the kit, but the individually sealed pill packs were not vented and so they expanded approximately 300 percent at the reduced cabin pressure. With over 300 pills in the kit, the sea level snug fit in the compartment became an inflight tight fit around the unused fasteners on the compartment wall.

The medical office has approved the venting of pill packages at the time of stowage for Apollo 12 and subsequent.

TIME: Crew debriefing

GFE-19

DESCRIPTION: The crew found the ear plugs uncomfortable to wear.

DISCUSSION: **CLOSED**
The molded noise-attenuation ear plugs were not worn by the Commander because of unfavorable preflight experience. The Lunar Module Pilot wore the plugs for the lunar landing but removed them after landing because of the discomfort. The plugs have been molded to fit the ear from both the standard material and from a softer material. Subjective ground tests have indicated no significant difference in comfort. The Apollo 11 crew is being provided ear plugs with and without the standard center hole. The one with the hole provides better communications contact, and the one without the hole provides better sound attenuation. In addition, Navy Ear Defenders are to be furnished to the crew for sleep evaluation the week of September 29, for possible adaptation to space use for LM-7 and subsequent.

TIME: Lunar surface activity

GFE-20

CLOSED

DESCRIPTION: Core tubes were difficult to drive into the lunar surface.

DISCUSSION: The two core tubes on Apollo 11 were equipped with internal tapered hard-anodized aluminum bits. The four core tubes on Apollo 12 will be equipped with external tapered stainless steel bits to decrease internal packing of the cores and resistance to drive.

There are no plans to include bits of other design in case the problems with coring the formations encountered at the Apollo 12 landing site differ from those encountered on Apollo 11.

Comparative tests using the Apollo 11 and 12 type bits in a simulated lunar soil are scheduled for the week of September 29.

TIME: Lunar surface activity

GFE-21

DESCRIPTION: Core tube assembly problems

DISCUSSION: a. Core tube caps were nearly thrown away with the net packing when the crew was unstowing the contents of the sample return containers.

Apollo 12 will have four caps for the four tubes. Three caps will be stowed on the cap bracket in one sample return container. The fourth cap will be stowed in a well marked bag in the other container. Apollo 11 did not carry the cap bracket because it carried only the two core tubes.

b. One follower clip was missing, one follower upside down, and one split core tube liner was out of register. However, the core samples were unaffected.

For Apollo 12 and subsequent, the assembly at the cleaning facility will include NASA assembly instructions and inspection. A Teflon plug has been added in the upper end of the split tube liner to maintain register. The follower and clip will continue to maintain register at the lower end (flange added to split tube at lower end for greater stability for Apollo 13 and subsequent).

c. One quick disconnect plug was inadvertently removed from the upper end of the tube by the crew and left on the lunar surface, leaving only the follower as a core retainer at the upper end. However, the Apollo 11 core sample was not lost.

For Apollo 12 and subsequent, a pip pin through the core tube body and quick disconnect plug will provide a positive lock so as to assure quick disconnect separation from the extension handle rather than an inadvertent threaded disconnect from the core tube.

TIME: Postflight inspection of liquid cooled garments

DESCRIPTION: During postflight pressure checks of the liquid cooled garments from Apollo 11, the LMP garment showed a liquid leak at the manifold connector through an annular break in the inner tube of the riser and a longitudinal rupture in the outer tube.

DISCUSSION: Assembly of the dash one manifold and riser at the vendor's plant provides for clamping and correct relationship of the end of fold nipple. The units were accepted as assembled at the vendor's plant.

Comparing the dash one assembled units at the Cape with the dash two drawing, which showed a maximum clearance of 1/16 inch between the end of the riser and the manifold body, a space of 3/16 inch was found, a DR written, and the gap closed to zero. (Dash two nipples are shorter than dash one nipples.)

Postflight examination shows that drawing the riser over the manifold nipple far enough for the reinforcing spring to ride up onto the nipple can result in shearing an annular cut in the inner wall.

The LMP and CDR liquid cooled garments were pressure checked at equal level of 31 psi, and subsequently examined by X-ray and disassembly, with the following observations:

- a. Both units showed no clearance between the end of the riser hose and the manifold body.
- b. Both units showed that spring reinforcement had been drawn up over the nipple, with more turns on the nipple for the CDR unit.
- c. Both units showed annular cuts in the inner tube of the riser near the first turn of the spring reinforcement.
- d. On the LMP unit, this allowed liquid into the space between the inner and outer tubes.
- e. On the CDR unit, the additional turns apparently sealed the inner tube against the nipple, preventing leakage.
- f. The outer tube of the LMP unit ruptured at 31 psig, from the pressure of the liquid which had leaked through the cut in the inner tube.

Dash two manifold assemblies will be used on Apollo 12 and subsequent. To insure proper assembly the dimension of the gap between the end of the riser hose and the manifold shoulder has been changed to 5/64 +1/16 -0 on all appropriate documents. All completed riser/manifold assemblies have now been examined by X-ray, and where springs have been drawn over nipples, the riser hose has been removed and installed properly.

UNITED STATES GOVERNMENT

Memorandum

PA/S. H. Simpson

TO : PT/D. D. Arabian

AUG 4 10 53 AM '69

DATE: August 1, 1969

In reply refer to:

PA-9-8-2

FROM : PA/Manager, Apollo Spacecraft Program

SUBJECT: Apollo 11 management debriefing

I picked up the following items of interest in the management debriefing. I assume that many of these are already on your various listings, and the purpose of this memorandum is to make doubly sure that there will be no omissions.

a. During the TLI burn, the FDAI deviated 1.5° from the launch vehicle trajectory. This could have caused a problem in the event a manual take-over was required. Why was this?

b. During separation from the S-IVB, the CSM autopilot apparently had difficulty in making up its mind concerning the direction of rotation. Was this an anomaly, or was it a procedural error?

c. After CSM hatch removal, there was a strong odor of burnt material in the tunnel. Any explanation?

d. Since MCC₄ was deleted, the flight plan did not include a required platform alignment. This should either have been included in the flight plan or have been caught by the ground.

e. The EMS residuals were 4 to 5 f.p.s. Would a more realistic tail-off characteristic help this situation?

f. One of the lights on the LM DEDA was not working.

g. Apparently we were considering a new approach to undocking for this flight and the crew recommended that we should again consider this for Apollo 12. Under this procedure, the capture latches would not be released until some time after the probe was extended. Larry Williams should investigate this procedure before we buy off on it.

h. During the LM platform drift check after undocking in lunar orbit, three successive measurements were further apart than anticipated. What caused this?

AUG 4 1969



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i. A connector on each PLSS took 10 minutes to make. Should this be redesigned?

j. LM cabin depressurization took too long. Do we need new procedures or a hardware change?

k. The leveling device on one of the experiment packages apparently did not work. If this same device is used on ALSEP, we should look into it.

l. The closeup stereo camera was hard to operate and tended to fall over. Is a redesign necessary?

m. The lunar equipment conveyer belt apparently performed its function in a most awkward manner. Isn't there a better way of doing this job?

n. The temperature in the LM was too cold during sleep. Can this be changed procedurally, or do we need a design change?

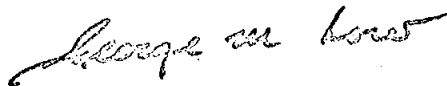
o. In the CSM, the VHF ranging broke lock 10 to 20 times. What caused this?

p. The CSM propellant utilization and gaging system again did not quite do what the crew expected it to do. Do we understand why?

q. During reentry, one of the yaw left thrusters on the Command Module may not have worked.

r. The biological isolation garment was uncomfortably hot and its visor fogged.

s. The crew observed flashes at the rate of about 1 per minute in the Command Module at night. Is there a physical explanation?



George M. Low

cc:

PA/G. W. S. Abbey

PA/C. H. Bolender

PA/K. S. Kleinknecht

PA/J. A. McDivitt

PA/S. H. Simpkinson

PD/O. E. Maynard

PD/J. G. Zarcaro

PE/O. G. Morris

PF/A. Cohen

PA:GMLow:jsw 8-1-69

MISSION EVALUATION ACTION REQUEST

Simpkinson

SUMMARY

PROCESSED
LM

CSM

WHAT IF'S

LM

CSM

INFO ONLY

LM

CSM

57 15
 78 20
 80 33
 81 35
 88 & 90 42
 CL93 43
 49
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 65
 65
 73
 82
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 CL93
 95
 96
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12 7
 19 CL27
 CL27 36
 29 44
 54 CL68
 59 70
 62 77
 CL68 99.4
 75
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1 3
 2 4
 14 5
 CL17 6
 CL24 8
 CL25 9
 26 11
 28 13
 30 16
 37 CL17
 LC38 18
 40 21
 CL46 22
 CL47 23
 51 CL24
 CL52 CL25
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 59 32
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 CL66 LC38
 67 41
 71 45
 74 CL46
 CL76 CL47
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6
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 (1
 canceled)

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-INFLIGHT.	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
L-1	H ₂ O TANKS	30	T-22:10	45	Prior TO T-0	18:00	
	IN40						
L-2	MISSION Rule 384	45	-9:00	FOD	T-7	26:16	
	modification						
C-3	H ₂ O ₂ Fill	45	1630	FOD	THRO OUT	8:11	
	sample results						
C-4	Batt A & B	30	-0820	45	ASAP	-7:36	
	CHARGE						
C-5	CHECK, FULL FLOW & RESET PRESS.	EECOM	-3:32	45	-2:00	-3:27	JULY 16, 1969
	VALVES ON BOTH O ₂ & H ₂ TANKS RELIEF VALVES	30					
C-6	DEFINE LIFTED COM	SPAN	-3:30	45	-2:00	-2:08	
	WATER VAPOR 20 YLBS. ALIQUOT	30					
C-7	ENG IN THE AIRPORT	30	-2:21	45	ASAP	-0:54	
	BURN CHARACTERISTICS						
C-8	ACS CHAD PRESSURE	FOD	-1:30	45	ASAP	-0:13	
		30					
C-9	VALVE OF H ₂ O IN POTENTIAL	FOD	-0:30	45	ASAP	GET 2:15	
	WASTE TANKS PRIOR TO TEST	30					

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
L-19	LR Self test	30	10:10	45	30:00	27:59	
	PGNS G4						
C-20	Jump in Fuel cell	30	10:30	45	before 0900 7-17-69	12:13	
	O ₂ Flow Rpt's						
C-21	Fuel cell	30	14:	45	1700	16:39	
	Temp Data						
	JULY 17, 1969						
C-22	FC#2 TEE DISTURBANCE	FOD	15:40	45	—	32:49	INFO & COMMENTS
		30					
C-23	CM O ₂ Purge	30	17:55	45	20:00	24:30	RE-OPENS C-15
CL-24	Lm/CM AP Reading	45	23:37	FOD	25:00	26:34	Intercom Standby
CL-25	Ref SODB OPERATIONAL	30 (Control)	28:35	45	30:00	54:00	
	Location GND C IR-16						
L-26	Reference GATE Comments to	30 Release	23:00	45 MER-11	29:00	31:33	
	Log's Activation Checklist						

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-10	Request for Part	FOD	GET, 03:48	45	ASAP	1:40	
	Apno-kr Status	(ECON)					
C-11	Record F/A. Test run	45	02:38	FOD	Every 12 hrs	4:40	
	Strip Chart	F/C		(ECON)			
L-12	"Q" Switch & comment	FOD	04:30	45	48:00	41:03	INTERVIEW
	P.	(ECON/Gen)		NER-H			27 1109?
C-13	Cryo Balance, Thermo	FOD	05:10	45	ASAP	6:32	
	J						
L-14	APS Low Level	FOD	7:32	45	29:30	26:48	
	50V LM-5						
C-15	Cosine on Equipment	45	6:58	FOD	ASAP	12:59	INTERVIEW BY
	Parse Flow						8:27 (See C-23)
C-16	Cryo Plv 50V	45	7:45	FOD	start of slam cycle	9:37	INTERVIEW BY
	Strip Chart						8:49
CL-17	LM/CSM Power	30	9:02	45	ASAP	12:26	
	Battery during 40						
C-18	SPS DC Data	30	9:57	45	ASAP	12:33	

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-IN-FLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-27	Steerable Antenna Acquisition	FOD Telecom	24:30	45 MER-H	3100	29:19	
L-28	Recovery of SODRB Checkpoint RP-17	FOD (ENTRN)	25:26	45 MER-H	30:00	33:49	
L-29	Circuit Malfunction J	FOD (ENTRN)	25:00	45 (MER-H)	30:00	31:34	
L-30	Circuit Malfunction J	FOD (Telecom)	25:03	45 MER-H	33:00	39:37	
C-31	Pc Meter Acctonm I	FOD	28:48	45	ASAP 31:00	35:04	
C-32	O ₂ Flow Transducer Malfunction	45	30:02	FOD	—	31:06	INTO ONLY!
C-33	O ₂ Tank Heaters	FOD	30:26	45	ASAP	37:14	Rec'd 45 Answer sent RETURNED 37:37
C-34	Addition of ECS Recovery of Component Check	45	30:37	FOD	PRIS TO LOZ	53:29	Inturn at 3430
C-35	Checklist changes due TO O ₂ Flow Sensor	30	30:04	45	48:00	50:18 76:10	Response sent back to 45 re 45:51

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-36	Prediction for	30 FOD	3223	45	3600	3711	
	O ₂ Flow C&W						
L-37	LR Aut. Position	30 FOD	3358	OM	5000	3433	
C-38	CSM RCS Thruster	30	3454	45	3900	42:10	
	CONST.						
C-39	O ₂ Flow Rate	30	3835	45	Info Only	3835	Info Only
	Data						
L-40	CHANGE TO LM CHECKLIST	FOD 30	39:09:00	45	44:00	50:35	
C-41	PRI RAD OUT TEMP EXCURSION	FOD 30	41:30	45	NONE	42:25	INFO ONLY
C-42	TCE	OM 30	46:58	45	49:00	51:12	
	FUEL CELLS						
C-43	S/S CHAMBER PRESS.	OM 30	47:00	45	51:00	53:15	
C-44	MADRID UPLINK SIGNAL	FOD 30	47:00	45	60:00	50:18	
	STRENGTH						

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-45	SPS Performance Curves	FOD	47:55	45	ASAP	51:12	
CL-46	S-Band Steerable	FOD (Telecom)	48:00	45 (HER-H)	52:00	59:39	
CL-47	LM TV Lighting ✓	FOD	50:00	45	—	52:18	
C-48	ECS Redundancy Check ✓	45 (ECS)	50:50	FOD	70:00	52:49	
C-49	O ₂ Flow Sensor (P.S. 235)	FOD	51:02	45	60:00	64:34	
C-50	ECS Malfunction Procedures	FOD	52:58	45	55:00	57:25	C50A CLOS-2 62:49
L-51	Race System /	FOD (Telecom)	53:10	45 (HER-H)	60:00	60:46	
CL-52	VHF Antenna Config. ✓	45	52:00	FOD	115:30	60:23	INTERIM 3+ 59:57
C-53	FM/FM Recording of Accumulator Cycles	FOD	54:20	—	None	70:11	NO RESPONSE KOD (Commence Config)

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST minus LO-PRELAUNCH GET-IN-FLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
L-54	LM Fracture Mechanics	FOD	55:20	45	6000	61:33	
L-55	Lunar Surface Optics Check	45	54:30	FOD	Info	60:53	
C-56	Redlines resulting from C-35, C-49, C-50	30	56:44	45	6200	63:26	
L-57	HGS Attitude Control Mode	FOD 30	57:40	45	6700	63:12	L-57B issued as update
C-58	FUEL CELL TCE & RADIATOR ANALYSIS	45	65:50	30	—	67:58	INFO ONLY
L-59	SPARE ECS PRI CART STOWAGE - LM	FOD 30	68:42	45	73:00	72:58	L-59A open 106:45 - C1624 & 107:46
C-60	Aggravation Kohol Valve	FOD	69:57	45	71:00	71:19	
C-61	PRIMARY COOLANT HEATER ACTIVATION	(640) 45	71:26	30 (640)	N/A	74:33	INFO
L-62	Heater/Valve Analysis Report Re-submit	FOD Telecom	72:00	45 (162-H)	79:00	77:18	

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-65	CSM High Gain Antenna Pointing Analysis	45 (MER-H)	73:40	FOD	—	74:55	Info Only
L-64	Docked Alignment Assurance	FOD (Control)	74:00	45 (MER-H)	81:00	79:52	
C-65	SPS G/L Lookng	SPAN (Athen)	76:19	45	80:00	88:08	
CL-66	Press Cm TO 5.7 PSI A	FOD 36	80:15	45	80:45	81:04	
L-67	DPS Erosion	30	81:30	45	84:30	83:35	
CL-68	Docking Probe Preload-malfunction	45	82:55	30 50	78:00	86:21	Interim of 84:44
C-69	SPS Cross over Time	FOD 30	83:36	45	85:00	85:28	
C-70	ECS Prim. Evap OUT Time	FOD 30	85:30	45	88:00	88:39	
	JULY 20, 1969						

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-IN-FLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
L-71	EPS MALFUNCTION PROCEDURES	45	7	30	124:23:26	124:24	
C-72	FUEL CELL TCE DATA	45	94:25	FOD/30	—	117:21	
C-73	SPS Fuel Rate Estimates	FOD	95:46	45	98:00	100:10	
L-74	L4 Descent Fuel Consumption	45 (HERN)	96:30	30 (HERN)	ASAP	98:49	
L-75	DPS Tank Fracture Limits	45	97:10	FOD	99:30	100:10	
C-76	Cryp Management	45	96:56	FOD	As Scheduled	101:02	
C-77	(No Ventral Vents)	45	97:20	FOD	ASAP	102:03	
	Lunar Touchdown				102:45:41 GET		(8:17:42 GMT) 20 JUL 69
L-78	MISSION Timer Failure	30	10330	45	ASAP	10600	

ACTION ITEM LOG							DATE
LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
P-79	PISS Xducer characteristics	30	10338	45	ASAP	10646	
L-80	Fuel Inlet Press. 603611P	30	10350	45	ASAP	10736	L-80 Returned to 45 10735
L-81	Less stable Ant. Ac.D.	30	10415	45	ASAP	112:00	
C-82	Evap Inlet Temp manual or Auto	45	10524	30	10615	10704	Interim 34 10639
C-83	PRI Evap out Temp Low	30	10534	45	ASAP	10736	
JULY 21/1971 CL-84	LM Perform RR Track of CSM	45	111:45:42	30	—	112:24	INFO ONLY
C-85	SPS PERFORMANCE DATA	30	112:14	45	ASAP	116:53	
C-86	ECS CO ₂ FILTER CHANGE	45	111:54	30	121:00	113:33	INTERIM AT 113:09
C-87	ECS PRIMARY EVAP	45	112:13	30	121:00	114:06	INTERIM AT 113:21

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST minus LO-PRELAUNCH GET-INFLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
L-88	BROKEN ASCENT ENGINE	30	113:12	45	118:00	122:48	INTERIM AT 118:57 MORE INFO REQUIRED L-88 (MEZ) closed 121:45
	ARM CIRCUIT BREAKER						
L-89	RR ORIENTATION	FOD 30	120:54	45	ASAP	122:48	
	AT LIFT OFF						
L-90	Problems For Ascent Engine Activation	45	121:15	FOD 30	124:00	122:48	
C-91	SP5. Cite. 1180 and engine had Temp. checks	45	123:25	FOD 30	Info Only	124:35	
C-92	All Propulsion Problems (544)	30	129:27	45	ASAP	131:05	
	JULY 22, 1969						
	RIS Thruster Activity At Docking	45 (MEZ-H)	146:49	FOD	149:00	150:34	
L-94	Descent LM-Descent Stage (Source Source)	FOD EASED	146:10	45	ASAP	152:58	
C-95	Back Contamination Administration	45	147:00	30	Info	158:10	C-95 H ISSUE C-95B issued C-95B sent up to C-95

ACTION ITEM LOG

DATE

LOG NR.	SUBJECT	REQUESTED BY	TIME OF REQUEST T minus LO-PRELAUNCH GET-IN-FLIGHT	ASSIGNED TO	REQUIRED TIME	TIME OF COMPLETION	NOTES
C-96	CONSTRAINTS ON PRESENT ATT.	30	15323	45	ASAP	15508	C96A ISSUED FOR CLARITY.
C-97	Cryo Heater O2 TANK 2	30	15747	45	17500	160:03	
	JULY 23, 1969						
C-98	CSM STOWAGE OF LM ITEMS	45	160:00	PDS ASPO	—	160:29	C-98A ISSUED 17906 CLARITY AT 1823
C-99	WATER DUMPING DURING PTC	FOD	162:13	45	170:00	164:12	
C-99.1	Battery Recharge Termination Criteria	45	17443	30	ASAP	17652	ISSUED NO. AT 17507 INTERIM AT 17543
C-99.2	Gas H ₂ O Separator Performance	45	17600	30	CREW STATUS REPORT	17823	ISSUED NO. AT 17657 INTERIM AT 17723
C-99.3	Thunderstorm Data	30	18000	45	RUSH	18157	
C-99.4	Entry P-1-5	FOD 30	183:21	45	186:00	188:24	

22. E

100 Form 2041 (Jan 80) (07)